

8.1 Indoor Air Quality

EPA has determined that the average U.S. citizen today spends 90% of his or her time indoors, and indoor air pollution levels can be up to 96 times greater than outdoor pollution levels. This makes indoor air quality, or IAQ, one of the greatest health concerns in this country. Poor air quality can have a significant impact on workers' health and productivity.

Opportunities

IAQ problems can be caused (or avoided) at virtually any stage in the design, construction, and operation of any facility. During *building design*, such issues as roof overhangs (to keep out rain), location of outside air inlet ports, glazing specifications (relative to potential condensation and mold growth), formaldehyde content of cabinetry, and entryway design to hold down tracked-in pollutants all can influence IAQ. During *construction*, such issues as wall system detailing to keep out wind-driven rain and practices to remove VOCs released from new building materials will affect IAQ. During *operation and maintenance*, such issues as the choice of cleaning agents, regulation of tobacco smoking, and maintenance of filters in air handlers affect IAQ.

Facility managers should not wait to address IAQ risks until problems arise. Become proactive in identifying and solving potential problems *before* they occur. Involve workers in the solution and take their complaints about IAQ seriously. Consider IAQ when renovating spaces, maintaining HVAC and other equipment, or contracting for janitorial services.

Technical Information

The three concepts below are often used to describe IAQ problems:

- **Sick building syndrome (SBS)** is a condition in which a significant number of building occupants (sometimes defined as at least 20%) display symptoms of illness for an extended period of time, and the source of these illnesses cannot be positively identified.
- **Building-related illness (BRI)** refers to symptoms of a diagnosable illness that can be attributed directly to a defined IAQ pollution source.
- **Multiple chemical sensitivity (MCS)** is a condition in which a person is sensitive to a number of chemicals, all at very low concentrations. This condition is not well understood but is often attributed to high levels of exposure to certain chemicals.

Other IAQ problems do not clearly fall into these three categories, however. Asthma and allergies (including allergic rhinitis—hay fever), for example, are very common and can be medically diagnosed, but there are many triggers, which vary widely from person to person; as a result, the source of particular triggers is not always easily identified.

IAQ SOURCES

Many factors can cause—or contribute to—IAQ problems. Sometimes it is a *combination* of different factors that causes problems—though any one of those factors, by itself, does not cause problems. Among these potential factors are the following:

Biological contaminants—including molds, bacteria, and dust mites—can result from roof leaks, water vapor entry from basements, inadequate drainage around buildings, leaking pipes, condensation from air-conditioning equipment, and the pests in a building (rodents, insects, etc.). Relative humidity that consistently exceeds 50% should be avoided. Bioaerosols emitted from certain organisms are recognized as a very significant problem. Some molds are particularly toxic, such as *Stachybotrys atra*, which has been implicated in infant deaths in Ohio.

Volatile organic compounds, or VOCs, can cause IAQ problems, particularly in new (or newly remodeled) buildings. Common sources of VOCs are paints, carpeting (especially carpet backings and adhesives), furnishings, and chemicals (such as solvents and cleaning agents).

Combustion by-products can create hazardous conditions if allowed to enter or accumulate in a building. Improper ventilation, inoperative or undersized exhaust fans, poor placement of ventilation air supply ports, and improper pressurization of the building can all lead to a buildup of combustion gases.

Particulates from a number of sources can cause IAQ problems. These include fiber shedding from fiberglass or mineral-wool insulation, ductboard, and mineral-fiber acoustic ceiling tiles; heavy metals and other compounds tracked into a building by employees or visitors; and soot from combustion devices.

CONTROLLING IAQ PROBLEMS

Avoiding or minimizing IAQ problems involves a seven-part strategy:

1. **Keep the building dry**—this is arguably the most important strategy, especially in quite humid regions of the country.

2. **Keep the building clean and pest-free**—for example, install a track-off system to capture particulates that might enter from outdoors.
3. **Avoid potential contaminant sources**—for example, particleboard and MDF products that offgas formaldehyde, adhesives, solvent-based cleaning agents, and sources of combustion gases.
4. **Reduce unplanned airflows**—these can result from unbalanced HVAC systems, the stack effect, or depressurization in buildings; and they can enable air pollutants to enter from outdoors (combustion gases, pollen), as well as moisture and radon or other soil gases through the floor slab or basement walls, for example.
5. **Provide exhaust ventilation** for unavoidable, strong, stationary pollution sources—these include photocopiers and laser printers in offices, cooking equipment, restrooms, and designated smoking areas.
6. **Provide filtered dilution ventilation** for people, interior finishes, and furnishings in a building—mechanical ventilation is necessary in most buildings to meet minimum ASHRAE standards.
7. **Educate designers, builders, and building occupants**—education is critical in minimizing the risk of creating IAQ problems, identifying problems as they occur, and effectively dealing with those problems.

A few specific recommendations for avoiding IAQ problems are provided in the list at right.

References

Building Air Quality: A Guide for Building Owners and Facility Managers, EPA/400/1-91/033, DHHS (NIOSH) Publication No. 91-114, U.S. Environmental Protection Agency, Washington, DC, December 1991; www.epa.gov.

Ventilation for Acceptable Indoor Air Quality (Standard 62-1989), American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), Atlanta, GA; www.ashrae.org.

Indoor Environment Business, monthly independent trade newspaper, IAQ Publications, Inc., Bethesda, MD; www.iaqpubs.com.

IAQ Guidelines for Occupied Buildings Under Construction, SMACNA, 1995; www.smacna.org/iaq.cfm.

A SAMPLING OF SPECIFIC MEASURES THAT PREVENT IAQ PROBLEMS

- **Air handlers** should be easy to clean and tightly sealed, have a minimum of joints and other dust catchers, and have effective filters.
- **Inspection of air handlers** should be made easier by good access doors and light- or white-colored surfaces inside the air handlers.
- **Condensate pans** inside air handlers should drain fully, and debris should be removed from the pans regularly.
- **Fresh air intakes** should be inspected to ensure that poor-quality air is not drawn into the building from “short circuits” between exhaust and air intakes or as a result of site-specific conditions such as wind. Look for standing water on the roof, bird feces or nests, and proximity to cooling towers, parking areas, waste stacks, exhaust vents, loading docks, and other nearby sources of contamination.
- **Ducts** should be easily cleaned, should be installed without interior insulation, and generally should be air-sealed; textile ducts, while not air-sealed, are the easiest to clean.
- **Floor drains** should be refilled periodically to prevent sewer gas from entering the building through dry traps.
- **Wall-to-wall carpeting** should be minimized and the use of carpet adhesives eliminated; install only products that meet the Carpet & Rug Institute IAQ standard.
- **Paints and adhesives** should contain no—or very low—VOCs. Interior painting should be done during unoccupied periods, such as weekends. Adequate “airing out” should be done to remove the majority of the VOCs from the air before re-occupancy.
- **Durable and easily cleaned building materials** should be used to eliminate the need for strong cleaning chemicals. For example, ceramic tile makes a good substitute for carpeting in entry areas and hallways.
- **Vinyl wall coverings** should not be used on interior surfaces of exterior walls where moisture from wall cavities can condense on the back of the vinyl and harbor mold.
- **“Wet” applied** and formaldehyde-containing wall coverings should be minimized.
- **Ventilation, temperature, and humidity** should comply with ASHRAE Standards 62-1989 and 55-94.
- **Isolate renovation work areas** with plastic sheeting. Tape off HVAC ductwork in renovation work areas to prevent dust and debris from entering the ducts.
- **Newly installed materials**, such as carpets and other flooring products, should be “aired out” before installation.